

# sonnen GmbH

## Company and Product Information pack



## Introduction

sonnen is driven by a vision to achieve safe, clean and affordable energy for all by harnessing the hugely beneficial potential of domestic battery storage technology. Our goal is to develop the safest technology solutions to continue to drive the move towards decentralized and digitalized electricity supply.

From the headquarters in Wildpoldsreid in Bavaria, sonnen has developed a proven and experienced management team, supported by more than 1,000 employees worldwide. As a wholly-owned subsidiary of Shell, sonnen is highly ambitious in its desire to further grow market share.



With over 100,000 systems installed worldwide, sonnen is firmly established as a market leader for domestic battery storage units. The sonnenBatterie is a complete, fully integrated energy storage solution with perfectly synchronized components including battery modules, integrated bi-directional inverter, and smart energy management system – supplied in one easy-to-install box. Much more than just a battery, the sonnenBatterie enables users to change the way they manage and control their energy.

Aside from hardware supply, our in-house expertise in the development of VPP (Virtual Power Plant) platform solutions and energy service models allows us to unlock the full benefits of the sonnenBatterie system.

Gary Watson  
Senior Manager, Sales (UK & Ireland)  
sonnen GmbH  
+44 (0) 7436 866 061 | [g.watson@sonnenbatterie.co.uk](mailto:g.watson@sonnenbatterie.co.uk)

## Company Details

**1,000** employees worldwide

Thanks to the sonnenCommunity, we **reduced CO<sub>2</sub> emissions by 183,000 t** globally.

**>1,000** Partners

Founded in **2010**

World's unique VPP technology for home storage

We operate our own battery labs

One of the world's leading manufacturers of smart energy storage systems

**>90,000** sonnenBatteries installed

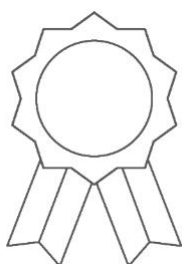
<b>Company name</b>	sonnen GmbH
<b>Registered address</b>	Innovationspark Allgäu, Am Reidbach 1, 87499 Wildpoldsreid Germany
<b>Company number</b>	10655 (Local Court Kempten/Allgäu, Germany)
<b>Ownership</b>	Shell Renewables and Energy Solutions (100%)
<b>Manufacturing locations</b>	- Wildpoldsreid, Germany - Atlanta, USA - Adelaide, Australia
<b>Websites</b>	<a href="http://www.sonnenbatterie.co.uk">www.sonnenbatterie.co.uk</a> <a href="http://www.sonnengroup.com">www.sonnengroup.com</a>
<b>sonnen UK &amp; Ireland principal contacts</b>	Gary Watson Senior Manager, Sales (UK & Ireland) Email: <a href="mailto:g.watson@sonnenbatterie.co.uk">g.watson@sonnenbatterie.co.uk</a> Mob: +44 (0) 7436 866 061  Richard Davies Technical & Compliance Manager (UK & Ireland) Email: <a href="mailto:r.davies@sonnenbatterie.co.uk">r.davies@sonnenbatterie.co.uk</a>  Wenzel Brühl Vice President (Growth Markets) Email: <a href="mailto:w.bruehl@sonnen.de">w.bruehl@sonnen.de</a>

# Why sonnen ?

## Safety and the environment

We use the safest battery technology available – Lithium iron Phosphate

At sonnen we only use ethically sourced materials. In line with this, we manufacture **cobalt-free**, lithium-ion batteries. As part of our commitment to the responsible disposal of used batteries, we are **WEEE registered** and ensure that used batteries are dealt with in accordance with these standards.



### Leading warranty

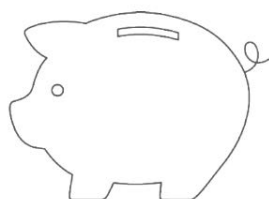
Full 10-year warranty

sonnen's fully comprehensive, industry-leading warranty of **10 years / 10,000 cycles** covers all components. This means that you only have one manufacturer to deal with for your battery system; and **backing from Shell** provides security that it will be upheld.

## Increased self-consumption

Increase your self-consumption by **up to 75%<sup>1</sup>** with a sonnenBatterie.

Households with solar PV typically use **just 30%** of the clean energy they generate, with any excess being lost to the grid. Battery storage collects energy that would otherwise be exported and saves it to be used when needed.



### Save on monthly bills

Save on your monthly bills by storing energy for later.

In addition to optimising self-consumption, a sonnenBatterie can provide additional savings by **charging from the grid** using an off-peak or time-of-use (ToU) tariff. Charging through these methods will provide further benefit during the winter months and is easy to configure using the sonnenPortal.

---

<sup>1</sup> The level of self-consumption depends largely on the general conditions under which the sonnenBatterie is operated. In particular, the size of the PV system as well as the sizing of the sonnenBatterie directly affect the level of self-consumption.

# sonnen videos re: battery technology and safety

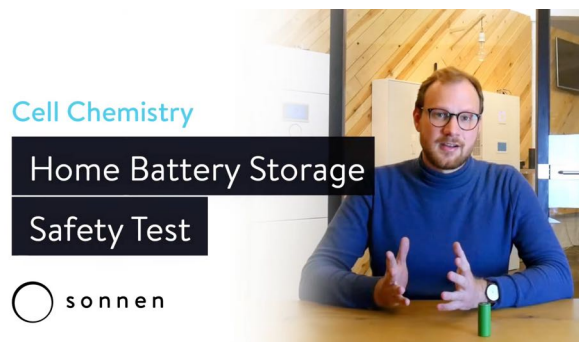
1. Comparison of battery technologies, our selection criteria, our testing

[youtu.be/O8YBtdIORYk](https://youtu.be/O8YBtdIORYk)



2. Home battery storage safety test

[youtu.be/3oBcljaJ3b0](https://youtu.be/3oBcljaJ3b0)



3. Who We Are – sonnen's battery technology

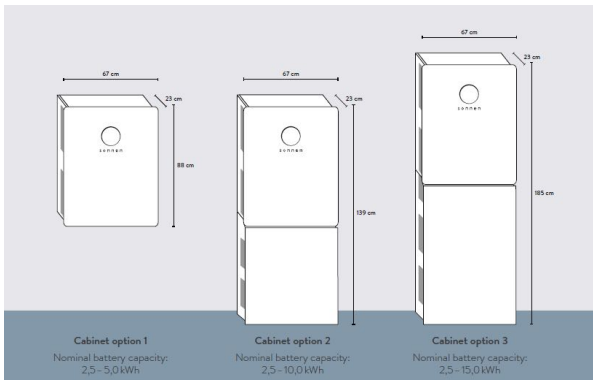
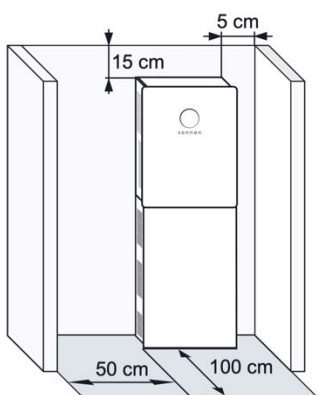
[youtu.be/l6jmrKcQ0Vc](https://youtu.be/l6jmrKcQ0Vc)



# Technical Overview

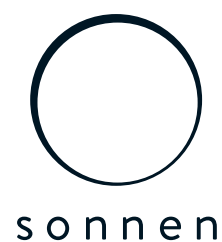
High level technical details for our products are shown below.

This table refers to the **sonnenBatterie Hybrid 9.53** (DC-coupled battery system):

Type	Value
System capacity	Modular system capacity from 5 kWh to 15 kWh in steps of 2.5 kWh
Usable capacity	Modular useable capacity from 4.5 kWh to 13.5 kWh in steps of 2.25 kWh
Nominal inverter rating	4.6kW dual MPPT hybrid inverter
MPPT Voltage rating	75V – 600V
Max PV input	7 kW
Max. power (charge/discharge)	2.5 kW (5 kWh systems and below) 3.3 kW (7.5 kWh systems and above)
Certifications	G98, G99, G100, EN50549-1 with Irish settings
Installation/IP rating	IP30
Warranty	10 years or 10,000 full loading cycles
Service life (battery modules)	20 years
Battery chemistry	Lithium Iron Phosphate (LiFePO4)
Enclosure material	Metal
Mounting	Main cabinet wall mounted; extension cabinet floor mounted
Dimensions	 <p>Cabinet option 1 Nominal battery capacity: 2.5-5.0 kWh</p> <p>Cabinet option 2 Nominal battery capacity: 2.5-10.0 kWh</p> <p>Cabinet option 3 Nominal battery capacity: 2.5-15.0 kWh</p>
Minimum spacing requirements	

Enclosure

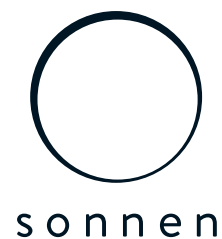
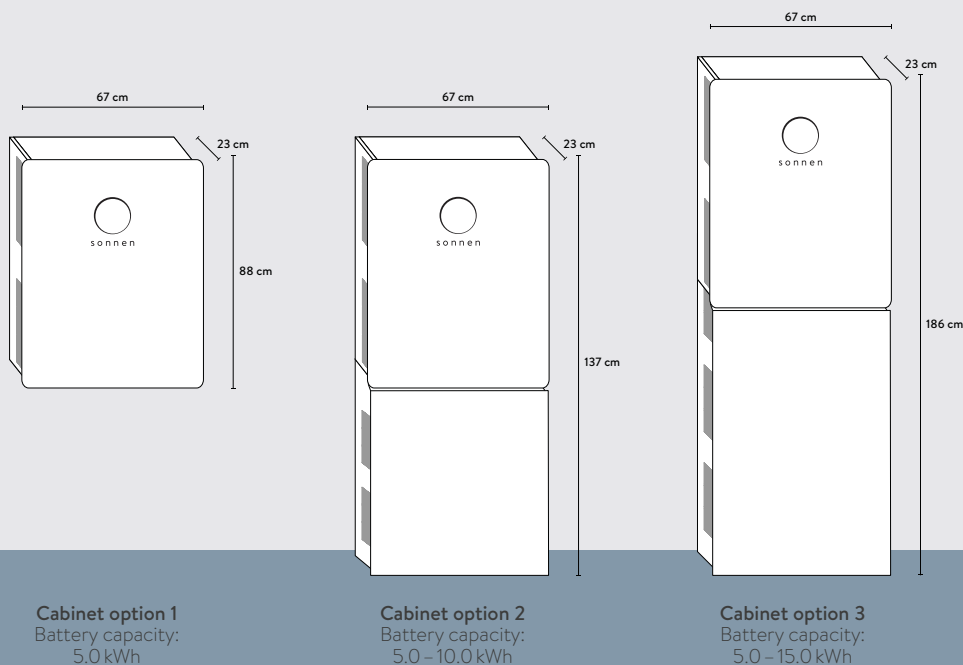
Technical datasheet and UK Declaration of Conformity for  
sonnenBatterie Hybrid 9.53



## Technical Data sonnenBatterie hybrid 9.53

	hybrid 9.53/5	hybrid 9.53/7.5	hybrid 9.53/10	hybrid 9.53/12.5	hybrid 9.53/15
Nominal battery capacity in kWh	5.0	7.5	10.0	12.5	15.0
Depth of discharge (DoD)	90%				
Cell technology	LFP (Lithium Iron Phosphate)				
Cabinet option 1 (5.0kWh)					
Weight in kg	81	-	-	-	-
Dimensions (H/W/D) in cm	88/67/23	-	-	-	-
Cabinet option 2 (5.0kWh - 10.0kWh) <sup>1</sup>					
Weight in kg	97	120	143	-	-
Dimensions (H/W/D) in cm	137/67/23	137/67/23	137/67/23	-	-
Cabinet option 3 (5.0kWh - 10.0kWh) <sup>1</sup>					
Weight in kg	108	131	154	177	200
Dimensions (H/W/D) in cm	186/67/23	186/67/23	186/67/23	186/67/23	186/67/23
Max. charging/discharging power in kW	2.5	3.3	3.3	3.3	3.3
Nominal power	4.6kW				
Input voltage PV	100 - 750VDC				
Max. input current PV	13A				
Number of MPP-Trackers	2				
MPP voltage range	75 - 600V				





## Technical Data sonnenBatterie hybrid 9.53

	hybrid 9.53/5	hybrid 9.53/7.5	hybrid 9.53/10	hybrid 9.53/12.5	hybrid 9.53/15
Power factor range	0.9 cap. – 0.9 ind.				
DC connection	Sunclix				
Max. efficiency (battery to grid)	95 %				
Max. efficiency (PV to grid)	97.5 %				
Max. battery efficiency	98 %				
Ambient temperature range	-5 °C – +45 °C <sup>2</sup>				
Dust & water protection	IP30				
Operating mode	single phase				
Tests and directives	Low Voltage Directive 2014/35/EU, EMC Directive 2014/30/EU, SGS TÜV Saar, IEC 62040-1, IEC 62109-1, IEC 62109-2, IEC 62619, UN38.3, IEC 62133, G83-2, G59-3, G100, EN50438				
Battery service life	designed for 20 years				
Warranty	10 years <sup>3</sup>				
Cycles	10,000 <sup>3</sup>				

We reserve the right to make technical changes and updates without prior notice. Specific values, performance data and other information in this data sheet, brochures and other product information, as well as illustrations and drawings in these documents, are solely illustrative and are subject to ongoing revision and modification. We do not warrant the accuracy or completeness of any information in these documents unless otherwise explicitly stated. Only the information in order confirmation documents or purchase contracts is binding.

<sup>1</sup> There are two cabinet versions available. By default, the large cabinet is included (Dimensions H/W/D 98/67/23). If a small cabinet is needed for a storage battery of 5.0 kWh up to 10.0 kWh, this must be specified when ordering. <sup>2</sup> Derating at approx. 35 °C. <sup>3</sup> Warranty on all parts. To learn more about our current warranty terms and conditions, please visit [sonnenbatterie.de/en/terms-and-conditions](https://www.sonnenbatterie.de/en/terms-and-conditions) or call our customer hotline and request a copy. · Standard housing color: white. Housing color black only on request.

## UK Declaration of Conformity

---

We manufacturer

**sonnen GmbH**

Am Riedbach 1 | D-87499 Wildpoldsried | Germany | +49 8304 92933 444

declare that the product

**sonnenBatterie hybrid 9.53**

is in conformity with the applicable essential requirements of the following:

---

---

### **Electrical Equipment (Safety) Regulations 2016**

---

EN 60730-1:2016 + A1:2019 Automatic electrical controls

EN 62109-1:2010 Safety of power converters for use in photovoltaic power systems

EN 62109-2:2011 Safety of power converters for use in photovoltaic power systems

IEC 60529:1989/AMD2:2013/COR1:2019 Degrees of protection provided by enclosures (IP Code)

IEC 62040-1:2019 Uninterruptible power systems (UPS) - Part 1: Safety requirements

---

---

### **Electromagnetic Compatibility Regulations 2016**

---

EN 61000-6-1:2007 Immunity for residential, commercial and light-industrial environments

EN 61000-6-3:2007 + A1:2011 Emission standard for residential, commercial and light-industrial environments

---

---

### **The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2019**

---

EN 50581:2012 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

---

---

Wildpoldsried, 28/06/2021



Norbert Hinz (CTO)

Enclosure

Safety data sheet – sonnenModule

## PRODUCT DATA SHEET / SAFETY DATA SHEET

0	<b>Date of issue/ Version</b>	03. November 2021 Version 3
1	<b>Description</b>	<b>Rechargeable lithium ion battery for energy storage</b>  <b>Proper Shipping Name: LITHIUM ION BATTERIES</b>
1.1	Trade name	LFP Lithium iron phosphate battery
1.2	Electro-chemical system	LFP Lithium iron phosphate
1.3	Anode (negative)	graphite
1.4	Cathode (positive)	LiFePO <sub>4</sub>
1.5	Type Details	<p><b>sonnenModule 0</b></p> <ul style="list-style-type: none"> <li>- Energy (Watt-hour rating) of the battery: 2240 – 3340 Wh</li> <li>- Voltage of the battery: 12,8 – 22,4 V</li> <li>- Ampère-Hours of the battery: 100 - 180 Ah</li> <li>- Weight of the battery: 22,4 – 33,6 kg</li> </ul> <p><b>sonnenModule 1</b></p> <ul style="list-style-type: none"> <li>- Energy (Watt-hour rating) of the battery: 2500 Wh</li> <li>- Voltage of the battery: 48 V</li> <li>- Ampère-Hours of the battery: 50 Ah</li> <li>- Weight of the battery: 22,5 kg</li> </ul> <p><b>sonnenModule 2 (Hybrid 9.53)</b></p> <ul style="list-style-type: none"> <li>- Energy (Watt-hour rating) of the battery 2500 Wh</li> <li>- Voltage of the battery: 48 V</li> <li>- Ampère-Hours of the battery: 50 Ah</li> <li>- Weight of the battery: 22,5 kg</li> </ul>

		<p><b>sonnenModule 3</b></p> <ul style="list-style-type: none"> <li>- Energy (Watt-hour rating) of the battery 2785 Wh</li> <li>- Voltage of the battery: 102,4 V</li> <li>- Ampère-Hours of the battery: 27,2 Ah</li> <li>- Weight of the battery: 28,6 kg</li> </ul> <p><b>sonnenModule 4 (sonnenBatterie 10)</b></p> <ul style="list-style-type: none"> <li>- Energy (Watt-hour rating) of the battery 5500 Wh</li> <li>- Voltage of the battery: 102,4 V</li> <li>- Ampère-Hours of the battery: 53,3 Ah</li> <li>- Weight of the battery: max. 40 kg</li> </ul> <p>The battery does NOT contain any metallic lithium.</p>
1.6	Contact Details	<p>Company Name: sonnen GmbH  Address: Am Riedbach 1, 87499 Wildpoldsried, Germany  Phone: +49 – 8304 – 92933-400  Fax: +49 – 8304 – 92933-401  Email address: <b>s.stede@sonnen.de</b></p> <p><b>24h Emergency Telephone Number:</b>  For Germany:  08304 – 92933-444</p> <p>International (other than Australia):  +49 – 8304 – 92933-444</p> <p>For Australia:  +61 437 193 638</p>

1.7	Regulatory Information Australia	These batteries are no hazardous “substances” or “mixtures” according to the Australian Work Health and Safety Legislation.
1.8	Regulatory Information EU	These batteries are no „substances“ or „mixtures“ according to Regulation (EC) No 1907/2006 EC. Instead they have to be regarded as „articles“. No substances are intended to be released during handling. Therefore there is no obligation to supply a „safety data sheet according to Regulation (EC) 1907/2006, Article 31“.
1.9	Regulatory Information USA	The products referenced in this document are “articles” under 29 CFR 1910.1200 and therefore articles are exempt from the Safety Data Sheet requirements. This Product Information Sheet is provided only as a service to our customers and is not based upon any requirement or regulation.
1.10		The information in this Product Data Sheet is provided as a service to our customers. The details presented are in accordance with our present knowledge and experiences. They are no contractual assurances of product attributes.

2	Hazard Identification	
2.1.1		The battery is sealed hermetically. When the battery is not violated or dismantled, the ingredients have no hazard potential.
2.1.2		Mistreatment of the battery (e.g. mechanical damage, extreme heat) may lead to an uncontrolled release of energy and to the release of heated contents. A spontaneously flammable gas mixture may be emitted that could ignite or cause a darting flame or a thermal runaway may occur. The smoke resulting thereof could irritate skin, eyes and throat. For emergency response, see chapter 4 to 6.
2.1.3		<p>Attention: If the battery is mistreated the danger of burns or bursts occurs. The battery must not be heated above 80°C or incinerated. The battery contents should not come in contact with water. If the battery content gets in contact with water hydrogen gas is formed, which may ignite spontaneously.</p> <p>Note: It seems contradictory but from fire fighting experience huge volumes of water are the best way of fighting a lithium ion battery fire. See chapter 4.</p>

<b>2.2.1</b>	<b>General Battery Hazards</b>	<ul style="list-style-type: none"> <li>- Under normal conditions of use, provided that the product enclosure remains closed, handling the product does not pose an electrical hazard.</li> <li>- Numerous safeguards have been designed into the product to help ensure that the battery is kept safe and secure as a result of a number of expected abuse conditions.</li> <li>- The product may pose an electrocution risk if the battery and/or safety circuits have been compromised or have been significantly damaged.</li> <li>- The battery even in a discharged condition is likely to contain substantial electrical charge and can cause injury or death if mishandled.</li> <li>- If the product has been significantly visibly damaged or its enclosure compromised, then practice appropriate medium voltage preventative measures until the danger has been assessed (and dissipated if necessary).</li> <li>- Warning: Never cut into a sealed product enclosure. Because then the danger of an internal short circuit, the danger of electrocution and of an uncontrollable dangerous chemical reaction exists.</li> <li>- For proper installation / removal instruction, please refer to the installation instructions.</li> </ul>
<b>2.2.2</b>	<b>Medium Voltage Battery Hazards associated with mechanical damage</b>	<p>Mechanical damage to the product can result in numerous hazard conditions. These include:</p> <ul style="list-style-type: none"> <li>- Leaked cell electrolyte</li> <li>- Rapid heating of individual cells due to exothermic reaction of constituent materials (cell thermal runaway), venting of cells and propagation of self-heating and thermal runaway reactions to neighbouring cells.</li> </ul> <p>To prevent mechanical damage to the product it should be stored and transported in the original packaging when not in use or prior to being installed.</p> <p>If the original packaging is not on hand, please contact sonnen GmbH (see 1.6) in order to get a replacement of that packaging.</p>



2.2.2.1	Hazards associated with leaked electrolyte	<ul style="list-style-type: none"> <li>- The electrolyte within the constituent cells in the battery includes a liquid and a dissolved lithium salt (which is a source of lithium ions) such as <math>\text{LiPF}_6</math>.</li> <li>- The electrolyte is largely absorbed in electrodes within the individually sealed cells.</li> <li>- Under normal battery usage conditions no one comes in contact with the cell electrolyte when properly handling the product.</li> <li>- Severe mechanical damage (e.g. severe crushing) can cause a small quantity of electrolyte (up to approximately 50 g) to leak out of cell. Only after a severe mechanical damage the user can come in contact with the electrolyte liquid.</li> <li>- The probability of a spill of electrolyte from the product is very remote.</li> <li>- Any released electrolyte liquid is likely to evaporate rapidly leaving a white salt residue. Evaporated electrolyte is flammable and contains human skin corrosive compounds. Leaked electrolyte is colourless and characterized by a pungent chemical odour. If such an odour is perceived, evacuate or clear the surrounding area and ventilate the area.</li> <li>- Warning: Avoid contact with electrolyte.</li> <li>- Leaked electrolyte solution is flammable and corrosive / irritating to the skin and the eyes. If a liquid is observed that is suspected electrolyte, ventilate the area and avoid contact with the liquid until a positive identification can be made and sufficient protective equipment can be obtained (eye, skin and respiratory protection).</li> <li>- Chemical classifier strips can be used to identify the spilled liquid (the electrolyte contains organic solvent and fluoride compounds).</li> <li>- In case of an electrolyte leak the following protective equipment is recommended: an air purifying respirator with organic vapor/acid gas cartridges, safety goggles or a full face respirator and safety gloves (Butyl rubber or laminated film (Silver Shield)). Protective clothing should be worn. Use a dry absorbent material to clean up a spill.</li> </ul>
---------	--	---

2.2.2.2	Hazards associated with vented electrolyte	<ul style="list-style-type: none"> <li>- Lithium ion cells are hermetically sealed units, and thus under normal usage conditions, venting of electrolyte should not occur.</li> <li>- If the cells are subjected to abnormal heating or other abuse conditions, electrolyte and electrolyte decomposition products can vaporize and be vented from cells.</li> <li>- Accumulation of liquid electrolyte is unlikely in the case of abnormal heating. Vented gases are a common early indicator of a thermal runaway reaction – an abnormal and hazardous condition.</li> <li>- If gases or smoke are observed to be escaping from the product, evacuate the area and notify a first responder team and/or the local fire department.</li> <li>- Gases or smoke exiting a lithium ion battery pack are likely to be flammable and could ignite unexpectedly as the condition that led to cell venting may also cause ignition of the vent gases.</li> <li>- A venting product should only be approached with extreme caution by trained first responders equipped with appropriate personal protective equipment (PPE).</li> <li>- Cell vent gas composition will depend upon a number of factors, including cell composition, cell state of charge, and the cause of cell venting.</li> <li>- Vent gases may include volatile organic compounds (VOCs) (such as alkyl-carbonates, methane, ethylene, and ethane), hydrogen gas, carbon dioxide, carbon monoxide, soot, and particulates containing oxides of nickel, aluminum, lithium, copper. Additionally PF<sub>5</sub>, POF<sub>3</sub> and HF vapours may form.</li> <li>- Warning. Avoid contact with vented gas.</li> <li>- Vented gases may irritate the eyes, skin, and throat.</li> <li>- Cell vent gases are typically hot: upon exit from a cell, vent gas temperatures can exceed 600 °C (1,110 °F). Contact with hot gases can cause thermal burns.</li> <li>- Vented electrolyte is flammable and may ignite on contact with a competent ignition source such as an open flame, spark or a sufficiently heated surface.</li> <li>- Vented electrolyte may also ignite on contact with cells undergoing a thermal runaway reaction.</li> </ul>
---------	--	---

3	<b>Composition/ Information on ingredients of the cells within the battery</b>																																																				
3.1	Ingredients	<p>Information on the ingredients of the cells used:</p> <table border="1" data-bbox="651 488 2029 1023"> <thead> <tr> <th data-bbox="651 488 1106 563">Content</th> <th data-bbox="1106 488 1330 563">CAS No</th> <th data-bbox="1330 488 1711 563">EHS/GHS</th> <th data-bbox="1711 488 2029 563">Concentration (% w/w)</th> </tr> </thead> <tbody> <tr> <td data-bbox="651 563 1106 603">Lithium iron phosphate</td> <td data-bbox="1106 563 1330 603">15365-14-7</td> <td data-bbox="1330 563 1711 603"></td> <td data-bbox="1711 563 2029 603">15-50%</td> </tr> <tr> <td data-bbox="651 603 1106 643">Graphite</td> <td data-bbox="1106 603 1330 643">7782-42-5</td> <td data-bbox="1330 603 1711 643"></td> <td data-bbox="1711 603 2029 643">10-25%</td> </tr> <tr> <td data-bbox="651 643 1106 683">Copper</td> <td data-bbox="1106 643 1330 683">7440-50-8</td> <td data-bbox="1330 643 1711 683"></td> <td data-bbox="1711 643 2029 683">5-30%</td> </tr> <tr> <td data-bbox="651 683 1106 722">Aluminium</td> <td data-bbox="1106 683 1330 722">7429-90-5</td> <td data-bbox="1330 683 1711 722"></td> <td data-bbox="1711 683 2029 722">2-30%</td> </tr> <tr> <td data-bbox="651 722 1106 762">Polyvinylidene fluoride</td> <td data-bbox="1106 722 1330 762">24937-79-9</td> <td data-bbox="1330 722 1711 762"></td> <td data-bbox="1711 722 2029 762">3-15%</td> </tr> <tr> <td data-bbox="651 762 1106 802">Carbon black</td> <td data-bbox="1106 762 1330 802">1333-86-4</td> <td data-bbox="1330 762 1711 802"></td> <td data-bbox="1711 762 2029 802">1-10%</td> </tr> <tr> <td data-bbox="651 802 1106 842">Polyacrylic acid (PAA)</td> <td data-bbox="1106 802 1330 842">9003-01-4</td> <td data-bbox="1330 802 1711 842"></td> <td data-bbox="1711 802 2029 842">3-15%</td> </tr> <tr> <td data-bbox="651 842 1106 882">Nickel</td> <td data-bbox="1106 842 1330 882">7440-02-0</td> <td data-bbox="1330 842 1711 882"></td> <td data-bbox="1711 842 2029 882">0-5%</td> </tr> <tr> <td data-bbox="651 882 1106 922">Electrolyte (proprietary)</td> <td data-bbox="1106 882 1330 922"></td> <td data-bbox="1330 882 1711 922"></td> <td data-bbox="1711 882 2029 922">10-20%</td> </tr> <tr> <td data-bbox="651 922 1106 962">Separator (proprietary)</td> <td data-bbox="1106 922 1330 962"></td> <td data-bbox="1330 922 1711 962"></td> <td data-bbox="1711 922 2029 962">4-10%</td> </tr> <tr> <td data-bbox="651 962 1106 1023">Other:</td> <td colspan="3" data-bbox="1106 962 2029 1023">Heavy metals like lead, cadmium and mercury are not used within the battery.</td> </tr> </tbody> </table>				Content	CAS No	EHS/GHS	Concentration (% w/w)	Lithium iron phosphate	15365-14-7		15-50%	Graphite	7782-42-5		10-25%	Copper	7440-50-8		5-30%	Aluminium	7429-90-5		2-30%	Polyvinylidene fluoride	24937-79-9		3-15%	Carbon black	1333-86-4		1-10%	Polyacrylic acid (PAA)	9003-01-4		3-15%	Nickel	7440-02-0		0-5%	Electrolyte (proprietary)			10-20%	Separator (proprietary)			4-10%	Other:	Heavy metals like lead, cadmium and mercury are not used within the battery.		
Content	CAS No	EHS/GHS	Concentration (% w/w)																																																		
Lithium iron phosphate	15365-14-7		15-50%																																																		
Graphite	7782-42-5		10-25%																																																		
Copper	7440-50-8		5-30%																																																		
Aluminium	7429-90-5		2-30%																																																		
Polyvinylidene fluoride	24937-79-9		3-15%																																																		
Carbon black	1333-86-4		1-10%																																																		
Polyacrylic acid (PAA)	9003-01-4		3-15%																																																		
Nickel	7440-02-0		0-5%																																																		
Electrolyte (proprietary)			10-20%																																																		
Separator (proprietary)			4-10%																																																		
Other:	Heavy metals like lead, cadmium and mercury are not used within the battery.																																																				
3.2	SVHC substances (Substances of very high concern) according to REACH (Article 33)	The battery does not include any SVHC substances according to REACH (Article 33).																																																			

4	<b>First Aid Measures at accidental release Medium Voltage Batteries</b>	
4.1	After electric shock/ electrocution	Seek immediate medical assistance if an electrical shock or electrocution has occurred (or is suspected).
4.2	After contact with leaked electrolyte	<p>The constituent cells within the battery are hermetically sealed. Contents of an open (broken) constituent cell within the battery can cause the following:</p> <p>After skin contact If materials from a ruptured or otherwise damaged cell or battery contact skin, flush immediately with water and wash affected area with soap and water. If a chemical burn occurs or if irritation persists, consult a physician.</p> <p>After eye contact Flush with significant amounts of water for 15 minutes without rubbing and consult a physician at once.</p> <p>After ingestion Drink plenty of water. Avoid vomiting. Consult a physician.</p>
4.3.1	After inhalation of electrolyte vapors	If inhalation of electrolyte vapors occurs, move person into fresh air. Consult a physician.
4.3.2	After inhalation of vent gas	<p>The constituent cells within the battery are hermetically sealed and venting of cells should not occur during normal use.</p> <p>If inhalation of vent gases occurs, move person into fresh air. Consult a physician.</p>

<b>5</b>	<b>Fire fighting measures</b>	
<b>5.1</b>	<b>Fire fighting measures General</b>	
5.1.1	Suitable extinguishing media	One of the following extinguishers shall be used: Dry chemical fire extinguisher Carbon dioxide fire extinguisher. Foam Large amounts of water
5.1.2	Special protection equipment during fire fighting	Wear positive-pressure self-containing breathing apparatus (SCBA) and protective fire fighting clothing (includes fire fighting helmet, coat, trousers, boots and gloves). If protective equipment is not available or used, fight fire from a protected location or safe distance.
5.1.3	Special hazards during fire fighting	- Cells may disassemble and release metal parts. - During a fire, smoke may contain the original material in addition to combustion products of varying composition which may be toxic and/or irritating. - Combustion generates toxic fumes i.a. the following: Carbon monoxides.
5.1.4	Surface Water Protection	Do not let used extinguishing media penetrate into surface water or ground water. If necessary thicken water with foam with suitable solids. Dispose off correctly. Apply respective local, national and/or international regulations on surface water protection.

<p><b>5.2</b></p>	<p><b>Fire fighting measures – Medium Voltage Batteries</b></p>	<p>Responding to a venting product:</p> <ul style="list-style-type: none"> <li>- Smoke emanating from a product is an indication of an abnormal and hazardous condition. The smoke is flammable and may ignite at any time. If fire or smoke is observed emanating from a product at any time, evacuate the area, and notify appropriately trained first responders and the local fire department.</li> </ul> <p>Through the fire the battery case may be damaged so that electrically conducting elements are disclosed. From this the risk of electrocution occurs. The product should then be monitored for evidence of continued smoke evolution.</p> <ul style="list-style-type: none"> <li>- Application of high volumes of water from a safe distance to cool the battery pack may prevent further reaction and prevent a fire from spreading.</li> <li>- If a fire develops the Incident Commander should suppress the fire (active firefighting).</li> <li>- A burning “SONNEN system” and its battery can basically be extinguished with water. It is not necessary to make a difference between the different versions of SONNEN lithium ion batteries.</li> <li>- Due to the design and the battery characteristics no special extinguishing agents are to be provided.</li> <li>- Fire ambient to the batteries are to be fought with conventional extinguishing agents. The fire of a battery cannot be considered separately from the surrounding fire.</li> </ul> <p>- Virtually all fires involving lithium ion batteries can be controlled with water. To date, water has been found to be the most effective agent for controlling lithium ion battery fires. Water will suppress flames and can cool cells, limiting propagation of thermal runaway reactions. If water is used, electrolysis of water (splitting of water into hydrogen and oxygen) may contribute to the flammable gas mixture formed by venting cells, burning plastic, and burning of other combustibles. Thus copious volumes of water should be used to fight a lithium ion battery fire.</p> <p>- Gaseous agents such as CO<sub>2</sub> or dry chemical suppressants may temporarily suppress flaming of lithium ion battery packs. But they will not cool lithium ion batteries and will not limit the propagation of cell thermal runaway reactions. Metal fire suppressants such as LITH-X, graphite powder or copper powder are not appropriate agents for suppressing fires involving lithium ion battery packs as they are unlikely to be effective.</p>
-------------------	---	---

		<ul style="list-style-type: none"><li>- A battery fire may continue for several hours and it may take 24 hours or longer for the battery pack to cool.</li><li>- A lithium ion battery fire that has been extinguished can re-ignite due to the exothermic reaction of constituent materials from broken or damaged cells. To avoid this, remove sources of ignition and cool the burned mass by flooding with water.</li></ul> <p><b>Active Firefighting:</b></p> <ul style="list-style-type: none"><li>- If a decision is made to actively fight a fire involving the product, then copious amounts of water should be applied from a safe distance.</li><li>- The water may not suppress all cell thermal runaway reactions within the battery pack, but it may cool cells and control the spread of the fire.</li><li>- If possible direct the application of water towards openings in the battery pack enclosure, if any have formed, with the intent of flooding the battery pack enclosure. The objective is to contact the surfaces of the affected and surrounding individual battery cells with water.</li></ul> <p><b>PPE (Personal Protective Equipment) for Firefighters</b></p> <ul style="list-style-type: none"><li>- Firefighters should wear self-contained breathing apparatus (SCBA) and fire protective turnout gear.</li><li>- Cells or batteries may flame or leak potentially hazardous organic vapors if exposed to excessive heat, fire or over voltage conditions.</li><li>- These vapors may include volatile organic compounds (VOCs), hydrogen gas, carbon dioxide, carbon monoxide, soot, and particulates containing oxides of nickel, aluminum, lithium, and copper.</li><li>- Additionally PF<sub>5</sub>, POF<sub>3</sub> and HF vapours may form.</li></ul>
--	--	--

<b>6</b>	<b>Accidental release measures</b>	
6.1	Person related measures	Wear personal protective equipment (PPE) adapted to the situation (protection gloves, face protection, breathing protection).
6.2	Environmental protection measures	Prevent spilled material from entering into soil, ditches, sewers, waterways and/or ground water.
6.3	Treatment for cleaning	<ul style="list-style-type: none"> <li>- Contain spilled material if possible.</li> <li>- Collect in suitable and properly labelled containers. Then store and dispose of according to local regulations.</li> </ul>
6.4		Personal protective equipment (PPE) see chapter 8.



7	<b>Handling and storage</b>	
7.1	<b>Guideline for safe handling for Medium Voltage Batteries</b>	<ul style="list-style-type: none"> <li>- Always follow the warning information on the batteries and in the manual.</li> <li>- Dangerous if mishandled.</li> <li>- Possible injury to property or person, including loss of life if mishandled.</li> <li>- A battery is a source of energy. Do not short circuit, puncture, incinerate, crush, immerse, force discharge, open, modify or expose to temperatures below or above the declared operating temperature range.</li> <li>- An internal or external short circuit can cause significant overheating and provide an ignition source resulting in fire, including surrounding materials or materials within the cell or battery.</li> </ul> <p>Under normal conditions of use, the electrode materials and electrolyte they contain are not exposed, provided the battery integrity is maintained and seals remain intact. Risk of exposure may occur only in cases of abuse (mechanical, thermal, electrical).</p> <p>If mishandling occurred:</p> <ul style="list-style-type: none"> <li>- Leave the room/area.</li> <li>- Avoid contact with the electrolyte.</li> <li>- Avoid breathing vapors. Avoid contact with the skin, eyes and clothing. Wear safety glasses with side shields.</li> <li>- Sources of ignition should be kept well clear.</li> <li>- Call the fire department.</li> <li>- Call the Hotline named under 1.6.</li> </ul>

7.1.2.1	Installation precaution – Medium Volt Batteries	<p>Elevated temperatures can result in reduced battery service life or a hazardous condition. The desired installation temperature for this product is between -5°C and 45°C (between 23°F and 113°F). Installation in areas with ambient temperatures over 45°C (113°F) is not recommended as this can result in degradation of product lifetime or a hazardous condition.</p> <p>Installation in areas where temperatures routinely approach or exceed 80°C (176 °F) could result in a hazardous condition. Do not install batteries near heating equipment.</p> <p>The installation area should be protected from flooding.</p> <p>Installation areas should be compliant with the appropriate local fire code requirements.</p>
---------	---	---

<b>7.2</b>	<b>Guideline for safe storage</b>	
<b>7.2.1</b>	<b>Guideline for safe storage General requirements</b>	Check all storage plans regarding your national and local requirements. And comply to the storage information accepted by your insurance company.
<b>7.2.1.1</b>	<b>Guideline for safe storage, safe storage areas and storage containers</b>	<ul style="list-style-type: none"> <li>- Storage preferably at room temperature (approx. 20°C).</li> <li>- Avoid large temperature changes.</li> <li>- Do not store close to heating devices.</li> <li>- Avoid direct sunlight.</li> <li>- At higher temperature the electrical performance may be reduced.</li> <li>- Storage Temperature: -20°C to +45°C</li> </ul> <p>Storage container:</p> <ul style="list-style-type: none"> <li>- Keep container tightly closed in a cool, well-ventilated place. Keep away from heat, sparks and flames.</li> </ul>

<p><b>7.2.1.2</b></p>	<p><b>Guideline for safe Storage</b></p> <p><b>Medium Voltage Batteries</b></p>	<p>The product should be stored in approved packagings prior to installation.</p> <p>Do not store the products in a manner that allows terminals to short circuit. Do not allow the formation of an electrically conductive path.</p> <p>Elevated temperatures can result in reduced battery service life. The product can withstand temperatures of -20°C to 60°C. However products stored for a longer time the modules should be stored at temperatures between 0°C and 40°C (between 32°F and 104°F) at humidity of less than 90% and protected from condensation. Do not store the products near heating equipment.</p> <p>The storage area should be protected from flooding.</p> <p>Extended storage areas should be compliant with the appropriate local fire code requirements.</p> <p>Acceptable storage density of battery packs and storage height of battery packs will be defined by the local authority having jurisdiction.</p> <p>USA: Requirements and limits will be based upon a number of factors including the structural and fire protection characteristics of the storage area and recommendations for fire protection promulgated by the National Fire Protection Association (NFPA) and similar organizations.</p> <p>At the time of this writing, no Commodity Classification has been defined for lithium ion cells or battery packs (See NFPA – 13 Standard for the Installation of Sprinkler Systems). Until a Commodity Classification has been defined based on testing by NFPA or a similar organization it is recommended to treating lithium ion cells and batteries in packaging as equivalent to a Group A Plastic Commodity.</p>
<p>7.2.2.1</p>	<p>EU Storage category according to TRGS 510</p>	<p>It is recommended to consider the „Technical Rule for Hazardous Substances TRGS 510 – Storage of hazardous substances in non-stationary containers“ and to handle rechargeable lithium ion batteries according to storage category 11 („combustible solids“).</p>

7.2.2.2	USA Storage – Warning Sign on battery room door – Battery storage room door	Hazard communication may be placed on storage areas or cabinets if required by local storage regulations.
7.2.3	Germany: Storage of large amounts	<p>Recommendations of the German Association of Indemnity Insurers (GDV – „Gesamtverband der Deutschen Versicherungswirtschaft e.V.“) concerning lithium batteries.</p> <p>A fire-extinguishing system shall reflect the extinguishing agents mentioned in chapter 5.</p> <p>Here the link to the complete text:  <a href="https://shop.vds.de/de/download/9950d8444e9ee37fb1a87d71cd4492a6/">https://shop.vds.de/de/download/9950d8444e9ee37fb1a87d71cd4492a6/</a></p>

<p><b>7.3</b></p>	<p><b>Handling, storage and transport of damaged medium voltage products</b></p>	<p>If a product has been damaged (battery enclosure has been dented or compromised), it is possible that heating is occurring that may eventually lead to a fire. Damaged or opened cells/batteries can result in rapid heating (due to exothermic reaction of constituent materials), the release of flammable vapors, and propagation of self-heating and thermal runaway reactions to neighbouring cells.</p> <p>Before handling or transporting a damaged product, wait at least 1 hour. Smoke may be an indication that a thermal reaction is in progress. If no smoke, flame, leakage of electrolyte, leakage of coolant or signs of heat has been observed for 1 hour, the product may be disconnected and moved into a safe location.</p> <p>To obtain specific instructions for evaluating, disconnecting, and preparing a damaged product for transport, please contact:</p> <p>For Germany: 08304 – 92933-444</p> <p>International (other than Australia): +49 – 8304 – 92933-444</p> <p>For Australia: +61 437 193 638</p> <p>A damaged product should be monitored during storage for evidence of smoke, flame, leakage of electrolyte, leakage of coolant, or signs of heat. If full-time monitoring of the product is not possible (for example during extended storage), the product should be moved to a safe storage location.</p> <p>A safe storage location for a damaged battery will be free of flammable materials, accessible only by trained professionals and at an appropriate distance from occupied structures. Refer to your national and local fire protection regulations for more details.</p> <p>Do not store damaged products adjacent to undamaged products.</p>
-------------------	--	--

		<p>It is possible that a damaged battery may sustain further damage during transportation that may lead to a fire. To further reduce this risk, handle the damaged battery with extreme caution.</p> <p>High voltage cables must not be damaged or separated from the high-voltage system by non-qualified personnel.</p> <p>Only correspondingly qualified personnel may directly handle high-voltage components if this is necessary during any measures to be performed on the product.</p>
<b>8.1</b>	<b>Exposure controls/ personal protection</b>	<p>Under normal conditions (during charge and discharge):</p> <ul style="list-style-type: none"> <li>- release of ingredients does not occur.</li> <li>- personal protection not required.</li> </ul> <p>If battery is damaged:</p> <p>Eye protection: Wear chemical goggles or face shield.</p> <p>Hand protection: Wear safety gloves if handling damaged battery.</p> <p>Body and skin protection: Where there is a potential of skin contact, have available and wear as appropriate: impervious gloves, apron, pants, jacket, hoots and boots.</p>
<b>8.2</b>	<b>General safety and hygiene measures</b>	<p>Wash hands before breaks and after handling the product.</p>

<b>9</b>	<b>Physical and chemical properties</b>	Not applicable if closed.
<b>10</b>	<b>Stability and reactivity</b>	
10.1	Reactivity	No hazardous reactions if stored and handled as prescribed/indicated. When heated above 80°C the risk of rupture occurs.
10.2	Chemical stability	Stable under normal storage conditions.
10.3	Possibility of dangerous/hazardous reactions	This battery is considered stable. However avoid contact with ignition sources (e.g. sparks, open flame, heated surfaces).
10.4	Conditions to avoid	Avoid all sources of ignition: heat, sparks, open flame.
10.5	Incompatible materials	Strong oxidizers.
10.6	Hazardous decomposition products	No hazardous decomposition products if stored and handled as prescribed/indicated.
<b>11</b>	<b>Toxicological information</b>	Under normal conditions (during charge and discharge) release of ingredients does not occur. In case of accidental release see information in chapter 2, 3 and 4.



<b>12</b>	<b>Ecological Information</b>	
12.1	European Directive 2006/66/EC Article 21	The lithium ion batteries do not contain heavy metals as defined in the European directive 2006/66/EC Article 21. They comply with the chemical composition of this Directive.
12.2	Mercury-Containing and Recharge-able Battery Management Act	Mercury has not been „intentionally introduced (as distinguished from mercury that may be incidentally present in other materials)“ in the sense of the U.S.A. „Mercury-Containing and Rechargeable Battery Management Act“ (May 13 1996).
12.3	Regulation on Mercury Content Limitations for Batteries dated 1997-12-31	The Regulation on Mercury Content Limitations for Batteries promulgated on 31st December 1997 by authorities of the People’s Republic of China including the State Administration of Light Industry and the State Environmental Protection Administration defines „low mercury“ as „mercury content by weight in battery as less than 0.025%“, and „mercury free“ as „mercury content by weight in battery as less than 0.0001%“. Therefore these lithium ion batteries belong to the category of mercury-free battery (mercury content lower than 0.0001%).
12.4	Info on hazardous substances resp. extremely hazardous substances (EHS)	These batteries do not contain sulphuric acid and these batteries are not considered extremely hazardous substances as per EHS.

13	Disposal consideration	
13.1	European Directive 2006/66/EC	<p>In the European Union manufacturing, handling and disposal of batteries is regulated on the basis of Directive 2006/66/EC of the European parliament and of the council of 6th September 2006 on batteries and accumulators and waste batteries and waste accumulators and repealing Directive 91/157/EEC.</p> <p>Costumers find detailed information on disposal in their specific member states using the website of the European Portable Battery Association:  <a href="http://www.epbaeurope.net/legislation_national.html">http://www.epbaeurope.net/legislation_national.html</a></p>
13.2	USA	<p>Lithium ion batteries are classified by the federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream.</p> <p>These batteries however do contain recyclable materials and are accepted for recycling by the Rechargeable Battery Recycling Corporation's (RBRC) Battery Recycling Program. Please go to the RPRC website at <a href="http://www.rbrc.org">www.rbrc.org</a> for additional information.</p> <p>If disposing without returning it to sonnen GmbH, please consult with local, state and/or federal authorities on the appropriate method for disposal and recycling.</p>
13.3	Other states	<p>Importers and users outside the EU and the USA should consider the national and local laws, rules and requirements.</p>
13.4	Preparation for disposal	<p>In order to avoid short circuit and heating used lithium ion batteries should never be stored or transported in bulk.</p> <p>Proper measures against short circuit are:</p> <ul style="list-style-type: none"> <li>- Storage of batteries in original packaging</li> <li>- Coverage of terminals</li> <li>- Embedding in dry sand</li> </ul>

<b>14</b>	<b>Transport Information</b>	
14.1	Identification	<p>Rechargeable lithium ion batteries manufactured by sonnen GmbH are identified as follows:</p> <p>Air Transport according to ICAO TI / IATA DGR:  UN No. UN 3480  Proper Shipping Name: Lithium Ion Batteries  Class: 9  Packing Instruction: 965, Section IA</p> <p>Road Transport according to ADG  UN No. UN 3480  Proper Shipping Name: Lithium Ion Batteries  Class: 9  Special Provision: SP 230  Packing Instruction: P903</p> <p>Road Transport according to ADR  UN No. UN 3480  Proper Shipping Name: Lithium Ion Batteries  Class: 9  Special Provision: SP 230  Packing Instruction: P903</p> <p>Road Transport according to 49 CFR Chapter I Part 173 Subpart E UN No.  UN 3480  Proper Shipping Name: Lithium Ion Batteries  Class: 9  Paragraph § 173.185 a, b</p>

		<p>Sea Transport according to IMDG Code:  UN No. UN 3480  Proper Shipping Name: Lithium Ion Batteries  Class: 9  Special Provision: SP 230  Packing Instruction: P903</p>
14.2	Manufacturing according to Quality Management Program	Rechargeable lithium ion cells and batteries manufactured by sonnen GmbH are manufactured according to the Quality Management Program described in 2.9.4 (e) ADG Code, 2.2.9.1.7 (e) ADR, 2.9.4.1 (e) IMDG Code and 3.9.2.6.1 (e) IATA DGR.
14.3	38.3 Test	Rechargeable lithium ion cells and batteries manufactured by sonnen GmbH are tested according to 38.3 of the UN Manual of Tests and Criteria as required by 2.9.4 (a) ADG Code, 2.2.9.1.7 (a) ADR, 2.9.4.1 (a) IMDG Code and 3.9.2.6.1 (a) IATA DGR.
14.4.1	Safety venting device	Rechargeable lithium ion cells and batteries manufactured by sonnen GmbH are equipped with a safety venting device in accordance with 2.9.4 (b) ADG Code, 2.2.9.1.7 (b) ADR, 2.9.4.1 (b) IMDG Code and 3.9.2.6.1 (b) IATA DGR.
14.4.2	Protection against dangerous reverse current	Rechargeable lithium ion batteries manufactured by sonnen GmbH have cells connected in parallel and serial and are equipped with effective means as to prevent dangerous reverse current required by 2.9.4 (d) ADG Code, 2.2.9.1.7 (d) ADR, 2.9.4.1 (d) IMDG Code and 3.9.2.6.1 (d) IATA DGR.
14.5	Declarations of Conformity	Test results as well as other relevant information required for transportation are given in dedicated „Declarations of Conformity“ if requested by the appropriate national authority.
14.6	State of Charge (SoC) Air Transport	Rechargeable lithium ion batteries shipped without equipment in air transport are manufactured at a State of Charge (SoC) not exceeding 30%. For used rechargeable lithium ion batteries shipped in air transport a maximum State of Charge of 30% needs to be ensured.

Enclosure

# What are the main lithium-ion chemistries ?



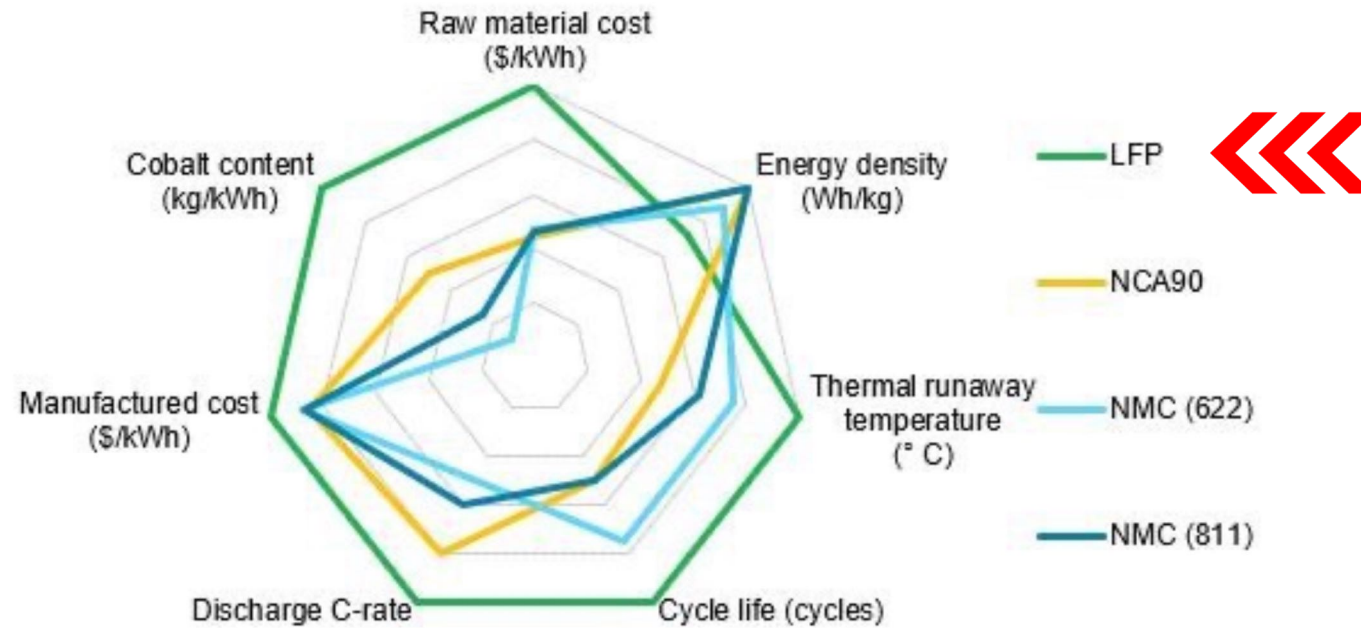
- Lithium Cobalt Oxide (LCO)
- Lithium Manganese Oxide (LMO)

<ul style="list-style-type: none"><li>- <b>Lithium Iron Phosphate (LFP)</b></li></ul>		<ul style="list-style-type: none"><li>- Good specific energy per cell</li><li>- Good specific capacity per cell</li><li>- Lower cost</li><li>- Excellent safety</li><li>- Excellent cycle life</li></ul>	
---	---	--	---

- Lithium Nickel Cobalt Aluminum Oxide (NCA)
- Lithium Titanate (LTO)

<ul style="list-style-type: none"><li>- <b>Lithium Nickel Manganese Cobalt Oxide (NMC)</b></li></ul>	<ul style="list-style-type: none"><li>- Good specific energy per cell</li><li>- Excellent specific capacity per cell</li><li>- Lower cost</li><li>- Good safety</li><li>- Good cycle life</li><li>- Poor tolerance if abused</li><li>- Contains cobalt</li></ul>
--	--

# Superior and safest chemistry



Note: The outer edge of the axis represents a desirable quality, the center of the chart is less desirable. Raw material costs and manufactured cost true as of July 20, 2020

**BloombergNEF**

# Stable chemistry for domestic use

## LFP

Lithium Iron Phosphate  
Used in all sonnen storage systems



VS

## NMC

Nickel Manganese Cobalt  
Used by many competitors



The nail test is a popular test to assess the safety of a battery cell: nail is driven through the cell to simulate an internal short circuit